

1 1. A method for forming an electrical conductor
2 with a plurality of electromigration-inhibiting/electrically
3 conductive plugs disposed between electrically conductive
4 segments of the electrical conductor, comprising the steps
5 of:
6 forming a row of aligned windows in a planar
7 surface;
8 depositing an electromigration-
9 inhibiting/electrically conductive material over the planar
10 surface and through the windows to fill the windows and
11 thereby provide, in such windows, plugs of electromigration-
12 inhibiting/electrically conductive material;
13 removing portions of the electromigration-
14 inhibiting/electrically conductive material to form the
15 plugs with surfaces co-planar with a surface surrounding the
16 plugs.

1 2. The method recited in claim 1, wherein the
2 distance between the windows is equal to or less than a
3 predetermined critical length, L_c , selected to inhibit
4 electromigration.

1 3. The method recited in claim 2, wherein the
2 conductor has a length, L , and wherein the number of windows
3 is equal to or more than $(L/L_c)-1$.

1 4. The method recited in claim 1 wherein the planar
2 surface includes an electrically conductive film and wherein
3 the electromigration-inhibiting/electrically conductive
4 material is deposited over the conductive film and into the
5 windows formed therein to provide, in such windows, the
6 plugs;

7 wherein, subsequently, portions of the deposited
8 material are removed to form the plugs with surfaces
9 co-planar with a surface surrounding the plugs; and
10 wherein the electrically conductive film is
11 patterned to form the electrically conductive segments
12 connecting the plugs.

1 5. The method recited in claim 4, wherein the
2 electrically conductive film is a multi-layer structure
3 including one or more layers of electromigration-inhibiting
4 refractory materials.

1 6. The method recited in claim 1 wherein the planar
2 surface includes a dielectric layer; and
3 wherein the electromigration-inhibiting/electrically
4 conductive material is deposited over the dielectric layer
5 and into the windows formed therein to provide the plugs;
6 and
7 removing portions of the deposited electromigration-
8 inhibiting/electrically conductive material to form the
9 plugs with a surface co-planar with exposed surface portions
10 of the dielectric layer surrounding the plugs.

1 7. The method recited in claim 6 including the steps
2 of:
3 forming trenches in the surface portions of the
4 dielectric film abutting and aligned with, the plugs;
5 depositing an electrically conductive material
6 deposited over the dielectric layer and into the trenches;
7 subsequently removing portions of the deposited
8 electrically conductive material from the dielectric layer
9 to form, in each one of the trenches, corresponding
10 electrically conductive segments with surfaces thereof co-

11 planar with each other, with the surface of the plugs, and
12 with surfaces of the dielectric layer, and connecting the
13 plugs.

1 8. The method recited in claim 7 wherein the
2 electromigration-inhibiting refractory metal liner and
3 electrically conductive material are deposited successively
4 into the trenches.

1 9. The method recited in claim 1 wherein the planar
2 surface includes a dielectric layer having an electrical
3 conductor disposed therein;

4 wherein the windows are formed in the electrical
5 conductor thereby separating the electrical conductor into
6 plurality of electrically conductive segments;

7 wherein the electromigration-inhibiting/electrically
8 conductive material is deposited over the dielectric layer,
9 over the electrical conductor and into the windows to
10 provide, in such windows, the plugs;

11 wherein portions of the deposited electromigration-
12 inhibiting/electrically conductive material are removed to
13 form the plugs with surfaces co-planar with a surface of the
14 dielectric layer and with surfaces of the electrically
15 conductive segments.

1 10. The method recited in claim 1 wherein an
2 electromigration-inhibiting/electrically conducting liner
3 and an electrically conducting material are deposited
4 successively into the windows.

1 11. The method recited in claim 4 wherein an
2 electromigration-inhibiting/electrically conducting liner

3 and an electrically conducting material are deposited
4 successively into the windows.

1 12. The method recited in claim 6 wherein an
2 electromigration-inhibiting/electrically conducting liner
3 and an electrically conducting material are deposited
4 successively into the windows.

1 13. The method recited in claim 9, wherein an
2 electromigration-inhibiting/electrically conducting liner
3 and an electrically conducting material are deposited
4 successively into the windows.

1 14. A method comprising the steps of:
2 forming a plurality of rows of aligned windows in
3 the planar surface;
4 filling the windows with electromigration-
5 inhibiting/electrically conducting material to form a
6 plurality of the plugs in the windows, a portion of such
7 material extending beyond the planar surface;
8 removing the portion of the said material extending
9 beyond the planar surface to form the plugs with
10 electrically conductive segments electrically interconnected
11 through the plugs.

1 15. A method for forming a multiconductor
2 metallization system with a distance between conductors less
3 than one micron comprising the steps of:
4 forming a plurality of equidistant rows of aligned
5 windows in the planar surface;
6 filling the windows with electromigration-
7 inhibiting/electrically conducting material to form a

8 plurality of the plugs in the windows, a portion of such
9 material extending beyond the planar surface;
10 removing the portion of the said material extending
11 beyond the planar surface to form the plugs with surfaces
12 co-planar with surfaces surrounding the plugs;
13 forming electrically conductive segments within the
14 same planar surface, abutting and electrically
15 interconnecting the plugs.

1 16. The method recited in claim 15, wherein the
2 planar surface includes a dielectric layer having an
3 electrical conductor disposed therein, and where the
4 electrical conducted segments are formed simultaneously with
5 the windows.

1 17. A multilevel metallization system, comprising:
2 a first metallization level of such system
3 comprising: first electrical conductors having each a
4 plurality of first electromigration-inhibiting/electrically
5 conducting plugs therein, the first plugs having co-planar
6 surfaces, the first electrical conductors comprising each a
7 plurality of first electrically conductive segments
8 electrically interconnected through the first plugs, the
9 first electrically conductive segments being co-planar with
10 each other and the first plugs;
11 electrically conductive vias passing through
12 apertures in a dielectric layer disposed on the first
13 metallization system to electrically interconnect the first
14 metallization level and a second metallization level;
15 such second metallization system comprising:
16 electrical conductors having each a plurality
17 of second electrically conductive segments electrically
18 interconnected through a plurality of second

19 electromigration-inhibiting/electrically conducting plugs,
20 the second electrically conductive segments and the second
21 plugs being co-planar.

1 18. A method of forming a multilevel metallization
2 system, comprising:

3 forming a first metallization level of such system
4 comprising: first electrical conductors having each a
5 plurality of first electromigration-inhibiting/electrically
6 conducting plugs therein, the first plugs having co-planar
7 surfaces, the first electrical conductors comprising each a
8 plurality of first electrically conductive segments
9 electrically interconnected through the first plugs, the
10 first electrically conductive segments being co-planar with
11 each other and the first plugs;

12 forming electrically conductive vias passing
13 through apertures in a dielectric layer disposed on the
14 first metallization system to electrically interconnect the
15 first metallization level and a second metallization level;

16 forming such second metallization system comprising:

17 forming electrical conductors having each a
18 plurality of second electrically conductive segments
19 electrically interconnected through a plurality of second
20 electromigration-inhibiting/electrically conducting plugs,
21 the second electrically conductive segments and the second
22 plugs being co-planar.

1 19. An electrical conductor, comprising:
2 a plurality of electrically conductive segments,
3 a plurality of electromigration-
4 inhibiting/electrically conductive plugs disposed between
5 the segments;

6 the electrical conductor has a length, L , the number
7 of such plugs being equal to or more than $(L/L_c)-1$, where L_c
8 is a predetermined critical length selected to inhibit
9 electromigration.

1 20. The electrical conductor recited in claim 19,
2 wherein $(R-R_0)/R_0$ is less than 0.01, where R is the
3 resistance of the electrical conductor and R_0 is the
4 resistance of an electrical conductor of equal length and
5 made of the same material as the electrically conductive
6 segments without the plugs.

1 21. An electrical conductor comprising:
2 a plurality of electrically conductive segments;
3 a plurality of electromigration-inhibiting/
4 electrically conductive plugs disposed between the segments;
5 such plugs comprising:
6 an electromigration-inhibiting/electrically
7 conductive liner; and,
8 an electrically conductive material.